Course Code: MTH 303
Course Title: Vector and Tenor Analysis
Credit Unit: 3
Time Allowed: 3 Hours
Total: 70 Marks
Instruction: Answer Question One (1) and Any Other 3 Questions

(1ai.) How do you write the formula for the Scalar product?   (3 marks)
(ii.) How do you find the product of two vectors?   (3 marks)
(iii.) When is the Scalar product of two vectors zero?   (3 marks)
(bi.) List 3 properties of the Scalar product.   (3 marks)
(ii.) What are the three laws of vector?   (3 marks)
(ci.) What is a vector triple product?   (3 marks)
(ii.) What is the condition for a vector triple product to be zero?   (4 marks)
(iii.) What is the cross product of two vectors?   (3 marks)

(2ai.) What is the normal derivative of Vector?   (3 marks)
(ii.) What is the derivative of a Vector?   (3 marks)
(iii.) Define Directional derivative.   (4 marks)
(bi.) Find the directional derivative of the function f(x,y) = xyz in the direction 3i – 4k. It has the points as (1,-1,1).   (5 marks)

(3ai.) Explain the two types of line integrals.   (3 marks)
(ii.) What does a positive value of a line integral in a vector field indicate?   (3 marks)

(iii) What does it mean when the value of a line integral is zero?   (3 marks)
(bi.) When is a surface integral said to be zero?   (2 marks)
(ii.) What's the relationship between surface integral and Gauss's law?   (2 marks)
(iii.) What is an example of a surface integral?   (2 marks)

(4ai.) What is the first Green's theorem?   (3 marks)
(ii.) What are the two forms of Green's theorem?   (2 marks)
(iii.) Use the Divergence Theorem to compute the outward flux of the vector field F(x, y, z) = (x, y, z) through the surface of the sphere $x^2 + y^2 + z^2 = 9$.   (3 marks)
(bi.) What is the divergence theorem of Gauss law?   (3 marks)
(ii.) Use the Divergence Theorem to find the flux of the vector field F(x, y, z) = (x^2, y^2, z^2) through the surface of the cube bounded by x, y, z = 0 and x, y, z = 1.   (4 marks)

(5ai.) Calculate the line integral using Stokes' Theorem. Let F = (y^2, x^2, z) be a vector field. Calculate the line integral ∫C F ·dr where C is the boundary of the surface S defined by the disk x² + y² ≤ 1 in the plane z = 0.   (4 marks)
(ii.) List 5 assumptions for Stoke's theorem.   (5 marks)
(bi) What are the conditions for Stoke's law to apply?   (3 marks)
(ii.) Calculate the following sum using summation conventions: $S = \sum_{i=1}^{n} a_i b_i$ where $a_i = 2i$ and $b_i = 3i + 1$ for $n = 4$ (3 marks)

(6ai.) Evaluate the line integral ∫C F · dr using Stokes' Theorem. Let F = (z, 0, -x) and let C be the curve defined by x² + y² = 1, z = 1.   (4 marks)
(ii.) What is the difference between covariant and contravariant vectors?   (3 marks)
(bi.) What is the rule for tensor Multiplication?   (3 marks)
(ii.) What is the product of two tensors?   (3 marks)
(iii.) What is the T product of tensors?   (2 marks)